Goal: The experiments in the CBRS band that we plan to conduct at 370 Jay Street, Brooklyn (NY) – 11201, are aimed to test, validate, and advance the algorithms proposed by the NYU team as part of two major NSF-funded programs [1, 2].

Infrastructure: The USRPs (N310, B210, X410) will act as base stations (gNodeBs, in 3GPP terminology) and users (UEs). They are all located in an indoor lab and run the open-source 5G codebase developed by the Open Air Interface Alliance [1], which provides fully customizable end-to-end 5G connectivity.

NSF-funded projects [2, 3]: The development and deployment of advanced, connected wearables in workplace environments faces significant technical, business, social, and logistical challenges. Our project seeks to overcome these challenges by completing four inter-connected tasks: Task 1 performs the first detailed, workplace-oriented study that assesses navigation accuracy of VIS^{4}ION, as measured using additional cameras and inertial measurement units; Task 2 builds on the current VIS^{4}ION interfaces to establish scalable, reproducible, and lower-cost tactile feedback, together with a new audio-based "cognitive assistant" for guidance; **Task 3 augments the wearable with high-speed 5G connectivity to provide real-time, powerful cloud-based machine vision processing**; Task 4 affords a series of novel studies to assess the workplace experiences of people with low vision and blindness via our partner, Lighthouse Guild. The assessment includes both "think aloud" recordings and contextualized reflections.

In [4], we studied the potential of wireless offloading of machine vision processing for a powerful, smart wearable for the Blind-and-Visually Impaired (BVI). The system, called VIS^{4}ION (Visually Impaired Smart Service System for Spatial Intelligence and Navigation) is a human-in-the-loop, sensing-to-feedback advanced wearable that supports a host of microservices during BVI navigation, both outdoors and indoors. The current VIS^{4}ION system is implemented as an instrumented backpack; more specifically, a series of miniaturized sensors are integrated into the support straps and connected to an embedded system for computational analysis; real-time feedback is provided through a binaural bone conduction headset and an optional reconfigured waist strap turned haptic interface. In the system studied, the wearable is augmented with multiple high-resolution cameras to increase the field of view (device-wise) and enhance functionality (the current system has a single stereo camera). When wireless connectivity is available, the camera data will be uploaded over a cellular network to a mobile edge server. We analyze the system in the case where the cellular wireless link can include high data rate 5G connectivity. Since the data rate in the multi-carrier system may be variable, we consider an adaptive video scheme where the number of camera feeds and bit rate per camera are adapted based on the estimated uplink wireless rate and delay.

Importantly, [4] is purely based on a simulated end-to-end 5G network. This experimental license will allow us to validate and advance our research by testing the proposed algorithms in the real-world.

Applicant: I indicated 'other' in question 12 because I will act as responsible/point of reference for the teamwork that will be conduct by NYU employees (students/staff/faculty).

References:

[1] Open Air Interface: The fastest growing community and software assests in 5G Wireless.
https://openairinterface.org/

[2] NSF SCC-IRG Track 2: Transportation Gaps and Disability-Related Unemployment: Smarter Cities and Wearables combating Commuting Challenges for the Visually Impaired
https://www.nsf.gov/awardsearch/showAward?AWD_ID=1952180&HistoricalAwards=false

[3] NSF Convergence Accelerator Track H: Smart Wearables for Expanding Workplace Access for People with Blindness and Low Vision
https://www.nsf.gov/awardsearch/showAward?AWD_ID=2236097&HistoricalAwards=false

[4] Network-Aware 5G Edge Computing for Object Detection: Augmenting Wearables to "See" More, Farther and Faster
https://ieeexplore.ieee.org/document/9730919